Controlled-Environment Cargo Container

Background of the Invention

1. Field of the Invention

The present invention relates to controlled-environment cargo containers, and more particularly to a method and apparatus for controlling components of a cargo container's environment, for example temperature and humidity.

Summary Of The Invention

The present invention is directed to configuring cargo containers to promote a horizontal flow in the container environment. As an additional benefit, when containers are so configured, certain expensive and ineffective components typically required in conventional containers may be omitted.

Brief Description Of The Drawings

These and other objects, features and advantages of the present invention will become more readily apparent upon considering the following detailed description of specific embodiments, with reference to the accompanying drawings where like numbers reference like elements, in which:

Figure 1 is a perspective side view of a cargo container according to one embodiment of the present invention;

Figure 2 is a transverse sectional view of the cargo container of Figure 1, looking from a second end toward a first end;

Figure 3 is a plan sectional view of the cargo container of Figure 1, a horizontal cutting plane passing through a roof assembly;

Figure 4 is a longitudinal sectional view of the cargo container of Figure 1, looking from a second side toward a first side, a vertical cutting plane having removed the first side from this view;

Figure 5 is a longitudinal sectional view of a cargo container according to a second embodiment of the invention, looking from a second side

toward a first side, a vertical cutting plane having removed the first side from this view;

Figure 6 is a longitudinal sectional view of a cargo container according to a third embodiment of the invention, looking from a second side toward a first side, a vertical cutting plane having removed the first side from this view;

Figure 7 is a plan sectional view of a cargo container according to a fourth embodiment of the invention, a horizontal cutting plane passing through a roof assembly;

Figure 8 is a plan sectional view of a cargo container according to a fifth embodiment of the invention, a horizontal cutting plane passing through a roof assembly; and

Figure 9 is a plan sectional view of a cargo container according to a sixth embodiment of the invention, a horizontal cutting plane passing through a roof assembly.

Detailed Description

1. Structure

Referring first to Figures 1 through 4, a cargo container according to one embodiment of the present invention is generally illustrated at ***10***. The cargo container includes a roof assembly ***12***, a floor assembly ***14***, first and second opposing side assemblies ***16***, ***18***, and first and second opposing end assemblies ***20***, ***22*** that cooperate to form an enclosed cargo compartment ***24***. It will be appreciated that the cargo compartment ***24*** could be enclosed by a different arrangement of assemblies without departing from the spirit of the invention. In this embodiment, the second end assembly includes a door sub-assembly ***26*** which has an open position to provide access to the cargo compartment ***24*** and an alternative closed position to seal the cargo compartment ***24***.

At least one of the first and second side assemblies ***16***, ***18*** includes a lateral

portion *28* within the cargo compartment *24*.

The cargo container *10* further includes a supply-conduit *30* adjacent the lateral portion *28* of the cargo compartment *24*. The supply-conduit *30* is placed, arranged, fitted and otherwise adapted to receive therewithin a fluid from outside the cargo compartment *24*. In this embodiment, the supply-conduit *30* is formed integrally from the structure of the cargo container *10*, and more particularly is illustrated as an integral portion of the first side assembly *16*.

The supply-conduit *30* includes a vent *32* passing radially therethrough and adapted to conduct the fluid within the supply-conduit *30* into the cargo compartment *24*. In this embodiment, the fluid conducted by the supply-conduit is substantially air.

Although the supply-conduit *30* is operable so as to ventilate the cargo compartment *24* with fluid received from outside the cargo compartment *24*, the cargo container *10* may also include a controller *34* having an input port *36* adapted to receive a fluid and an output port *38* adapted to supply the fluid received at the input port *36*. The controller *34* is operable to urge an environmental component of the fluid supplied at the output port *38* toward a desired value. For example, the controller *34* might include a heater *40* for increasing the temperature of the fluid, a cooler *42* for decreasing the temperature of the fluid, a humidifier *44* for increasing the humidity of the fluid, or a dehumidifier *46* for decreasing the humidity of the fluid. These aspects are shown diagrammatically in Figure 2, for example. In this embodiment, the output port *38* of the controller *34* is connected to supply fluid to the supply-conduit *30* so as to provide more control over the environment within the cargo compartment *24*.

The cargo container *10* may additionally include a return-conduit *50* having a

first end *52* connected to the cargo compartment *24* and a second end *54* connected to the input port *36* of the controller *34*. So arranged, the return-conduit *50* is operable to conduct fluid from the cargo container *24* to the controller *34*, so as to form a closed system with the supply-conduit *30* and the controller *34* for controlling and recirculating fluid. In this embodiment, the return-conduit *50* follows along the roof assembly *12*; however, other placements would be possible without departing from the spirit of the invention.

The cargo container *10* may further include a pump or fan *56* connected in series with the supply-conduit *30*, the controller *34* and the return-conduit *50*. The pump or fan 56 is operable to provide additional motive force for circulating the fluid, beyond any thermodynamic forces otherwise present in the passive system formed by the supply-conduit *30*, the controller *34* and the return-conduit *50*.

Finally, because no ducting need follow along the floor assembly *14*, there is no need to include T-rail floor panels. Thus in this embodiment, the floor assembly *14* includes a simple and robust corrugated floor *58*.

Referring now to Figure 5, a cargo container according to a second embodiment of the invention is generally illustrated at *10a*. In this embodiment, the vent *32a* is elongated and oriented substantially vertically within the cargo compartment *24a*. The vent *32a* may extend substantially from the top of the cargo compartment *24a* proximate the roof assembly *12a* to the bottom of the cargo compartment *24a* proximate the floor assembly *14a*. The vent *32a* defines a plurality of holes *60a* through the supply-conduit *30a* that are each adapted to conduct fluid within the supply-conduit *30a* into the cargo compartment *24a*.

Referring now to Figure 6, a cargo container according to a third embodiment of

the invention is generally illustrated at ***10b***. In this embodiment, the vent ***32b*** is also elongated and oriented substantially vertically within the cargo compartment ***24b*** and may extend substantially from the top of the cargo compartment ***24b*** proximate the roof assembly ***12b*** to the bottom of the cargo compartment ***24b*** proximate the floor assembly ***14b***. However, in this third embodiment, the vent ***32b*** defines an elongated slot ***60b*** through the supply-conduit ***30b*** that is adapted to conduct fluid within the supply-conduit ***30a*** into the cargo compartment ***24b***.

Referring briefly to both Figures 5 and 6, the interior cross-section of the supply-conduit ***30a***, ***30b*** may vary inversely with the distance between the cross-section and the fluid supply at the output port ***38a***, ***38b*** of the controller ***34a***, ***34b*** as measured along the longitudinal axis of the supply-conduit ***30a***, ***30b***. This decreasing interior cross-section at portions of the supply-conduit ***30a***, ***30b*** remote from the controller ***34a***, ***34b*** helps to make the pressure of fluid within the supply-conduit ***30a***, ***30b*** more uniform throughout its length.

Referring now to Figure 7, a cargo container according to a fourth embodiment of the invention is generally illustrated at ***10c***. In this embodiment, the supply-conduit ***30c*** is an independent assembly separate from the structure of the cargo container ***10c***. The supply-conduit ***30c*** may be attached to the cargo container ***10c***, and as illustrated is attached to the lateral portion ***28c*** of the cargo compartment ***24c***.

Referring briefly now to Figures 2 and 7, it can be observed that the supply conduit ***30***, ***30c*** in the first and fourth embodiments is substantially within the cargo compartment ***24***, ***24c***.

Referring now to Figure 8, a cargo container according to a fifth embodiment of the invention is generally illustrated at ***10d***. Just as in the first embodiment of

the cargo container ***10***, the supply-conduit ***30d*** is formed integrally from the structure of the cargo container ***10d***, and more particularly is illustrated as an integral portion of the first side assembly ***16d***. However, in the case of the fifth embodiment, the supply-conduit ***30d*** is substantially outside the cargo compartment ***24d***.

Referring finally now to Figure 9, a cargo container according to a sixth embodiment of the invention is generally illustrated at ***10e***. Just as in the fourth embodiment of the cargo container ***10c***, the supply-conduit ***30e*** is an independent assembly separate from the structure of the cargo container ***10c***. However, while the supply-conduit ***30e*** may be attached to the cargo container ***10c***, in this sixth embodiment it is substantially outside the cargo compartment ***24e***.

2. Operation

Referring now to Figures 1 through 9, the operation of the six embodiments of the cargo container ***10***, ***10a***, ***10b***, ***10c***, ***10d***, ***10e*** will now be described. Except when reference is being made specifically to an alternate feature of one of the alternate embodiments, the alphabetic suffixes will be omitted from all reference numbers for the purpose of simplicity.

With the door sub-assembly ***26*** placed in its open position, the cargo compartment ***24*** is made accessible for loading cargo. The corrugated floor ***58*** incorporated into the floor assembly ***14*** provides a robust surface for loading and securing the cargo and the corrugations help to carry any water that may accumulate within the cargo compartment ***24*** away from the cargo. Once the cargo has been loaded into the cargo compartment ***24***, the door sub-assembly ***26*** is placed in its closed position to seal the cargo compartment ***24***.

Either during loading or after the cargo compartment ***24*** has been sealed, an

operator can set the controller *34* to urge an environmental component of the fluid supplied at the output port *38* toward a desired value, for example a desired temperature or humidity. The operator can also engage the pump or fan *56* to provide motive force to circulate the fluid through the controller *34* to the supply-conduit *30*, on through the vent *32* into the cargo compartment *24*, and then back through the return-conduit *50* to the controller *34*.

With the supply-conduit *30*, the vent *32*, and the return-conduit *50* being oriented as previously described, the fluid flow through the cargo compartment *24* has a significant horizontal component, as is advantageously found in warehouse facilities.

While specific embodiments of the invention have been described and illustrated, such embodiments should be considered illustrative of the invention only.